Indra reserves the right to modify these specifications without prior notice.

AINE ADVANCED IP NETWORK EMULATOR

Satellite communications, earth observation, navigation and positioning and control stations

**Highlights**

- Flexible and extensible: new emulation models can be included in the library
- Built-in generation and analysis of irregular bit error (BER) patterns
- Includes impairments and protocols specific to the DVB-S/RCS networks
- Based on a Java 2 platform
- Remote configuration, monitoring and control through a Java-based GUI

**AINE characteristics**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Ethernet in promiscuous mode</td>
</tr>
<tr>
<td>Scalability</td>
<td>Host scalable from 8 kbps to 10 Gbps</td>
</tr>
<tr>
<td>Architecture</td>
<td>Distributed architecture: complex models can be easily distributed into several hardware platforms</td>
</tr>
<tr>
<td>Platform</td>
<td>GNU/Linux kernel 2.6 x86</td>
</tr>
<tr>
<td>Configuration</td>
<td>Java-based GUI</td>
</tr>
<tr>
<td>Protocols</td>
<td>IP, Ethernet</td>
</tr>
<tr>
<td>Native POSIX Threads Library (NPTL)</td>
<td></td>
</tr>
<tr>
<td>Traffic generation</td>
<td>Internal: UDP/IP with configurable profiles; External: end-user applications and bulk traffic generation tools</td>
</tr>
<tr>
<td>Emulator timers resolution</td>
<td>1 ms (Linux kernel resolution)</td>
</tr>
<tr>
<td>Dynamic storage of monitoring results</td>
<td>Flat files</td>
</tr>
<tr>
<td>Number of results per graph</td>
<td>Customize</td>
</tr>
</tbody>
</table>

**Extensible and feature-rich blocks library**

- Generic packet handling blocks: Traffic classifier, ToS marker, TTL decrement, traffic conditioning blocks (token bucket), MTU limiter, delay, bit-error-rate and packet-error rate, bandwidth limitation (leaky bucket) and queuing emulation.
- Network monitoring blocks: Bandwidth probe, packet time stamping, packet delay metering.
- Satellite networks specific blocks: L2 emulation: encapsulation of IP packets, ATM layer, PSRC and ATM cells; DAMA algorithms: emulation of narrowband (and ATM) DAMA and DAMA/V-slot algorithms; DAMA Agent and DAMA Controller messages exchange and terminals dynamic bandwidth assignment; RA algorithms: emulation of slots assignments in Random Access Mode combined to the DAMA mode, Supporting slotted Aloha (SA), Diversity SA (DSA) and ESA CRDSA.

**Supporting institutions**

The European Space Agency (ESA), the Instituto Nacional de Técnica Aeroespacial (INTA), the Instituto Nacional de Recursos Hídricos (IDRHI), the Instituto Nacional de Tecnología y Tecnología Industrial (INTI) and the Universidad Nacional de Ingeniería (UNI).

**Contact information**

Indracompany.com

Satellite communications, earth observation, navigation and positioning and control stations

**AINE characteristics**

- Ethernet in promiscuous mode
- Host scalable from 8 kbps to 10 Gbps
- GNU/Linux kernel 2.6 x86
- Java-based GUI
- XML files
- C/C++
- IP, Ethernet
- Native POSIX Threads Library (NPTL)
- Distributed
- Internal: UDP/IP with configurable profiles
- External: end-user applications and bulk traffic generation tools: iperf...
- 1 ms (Linux kernel resolution)
- Scalable
- Bandwidth and speed
- Interfaces
- Platform
- Monitoring and control
- Configuration
- Emulator programming language (core)
- Protocols
- Multithreading
- Architecture
- Traffic generation
- Emulator timers resolution
- Number of results per graph
- Customize

**AINE**

**ADVANCED IP NETWORK EMULATOR**

The advantage to know the performance of real applications over an IP network before launch.
Introduction

New applications and communications services typically require new access and services within the so-called "multimedia and IP technology" framework. The paradigm used today is using the same network layer (IP) for all types of communications services, from the access network to the core network.

Emulation at IP layer is a very attractive alternative way to validate applications performance in a lab environment. Reproducing as much as possible the impairments, impairments, buffering and delays of the real network is achieved.

I. Applications layer QoS in DVB-S/RCS systems (AQN)

The objective of this project was to provide an overall network characterization of a DVB-S/RCS system with several media devices (video, Internet and voice) in an integrated system that includes support for several Quality of Service (QoS) classes and a full protocol stack for both forward and return link.

AINE was used to emulate the DVB-S/RCS network with a DVB-S Hub and up to 51 terminals. AINE also included the DAMA and scheduling schemes that serve DVB S/RCS terminals, and the protocol stacks at the IP layer was also evaluated.

II. Applications layer QoS in DVB-S/RCS systems (AIME)

The advantage to know the performance of real applications over an IP network before launch

The real network is modeled through a set of connected emulation blocks that pass packets from one to another introducing specific impairments or measuring certain parameters, e.g., bandwidth, delay, packet losses...

Emulation models can be run on a set of PCs and be remotely monitored and controlled from any standard PC using a Java based client GUI.

Success stories II

The AINE modelled the DiffServ architecture and all DAMA related aspects of the DVB-S/RCS system with one DVB-S Hub and up to 51 terminals. The network model was divided and executed in two servers, one for the return link and the other for the forward link.

Applications layer QoS in DVB-S/RCS systems (AIME)

The AINE modelled the DiffServ architecture and all DAMA related aspects of the DVB-S/RCS system with one DVB-S Hub and up to 51 terminals. The network model was divided and executed in two servers, one for the return link and the other for the forward link.

Success stories III

The emulation provided in-depth validation of the proposed cross-layer optimization techniques and algorithms. AIME was used to test real video IP streaming applications before the satellite launch.

Applications layer QoS in DVB-S/RCS systems (AIME)

The selection model, with 51 terminals, was executed in a single dual processor server. AIME allowed the client to test a new architecture at the other for the forward link.
The advantage to know the performance of real applications over an IP network before launch

Introduction

New applications and communications services that use IP technology are being developed and made available in the so-called "multimedia and IP technology" network. This paradigm represents the use of the same network layer (IP) for all types of communications: data, voice, and video.

Emulation at IP layer is a very cost-effective way to validate applications performance over satellite. Reproduce at lab the final system behavior emulating in real time the network structure and limitations, such as buffers, delays, jitter, bandwidth bottlenecks, and packet losses of real satellite networks.

AINE ADVANCED IP NETWORK EMULATOR

AINE was used to simulate American systems TCP-encapsulated broadcast allocation and protocol stack in order to allow testing of facilities such as bandwidth assignment techniques in the scenarios of the web browsing gateway internet access (web browsing) and VoIP.

Success stories I

AINE was used to emulate AmerHis system dynamic bandwidth allocation and packet prioritization to allow in-factory evaluation of the impact of dynamic bandwidth assignment techniques in the services offered by Indra AmerHis gateway: Internet access (web browsing) and VoIP.

This model was executed on a desktop PC. AINE allowed Indra to test and validate IP services in realistic conditions before the satellite launch.

Interactive broadband DVB-S/RCS OBP communication system (AmerHis)

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=7923

AmerHis gateway

AmerHis terminal

Satellite

Internet

Success stories II

The AINE modelled the DiffServ architecture and all DAMA related aspects of the DVB-S/RCS system with one DVB-S Hub and up to 51 terminals. The network model was divided and executed in two servers, one for the return link and the other for the forward link.

The return link model, with 51 terminals, was executed on a dedicated dual processor server. AINE allowed the client to test a new architecture and to evaluate the expected QoS.

Applications layer QoS in DVB-S/RCS systems (AQoS)

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=27802

The objective of this project was to provide an overall network performance characterization of the DVB-S/RCS protocol stack and to evaluate the AINE model for the DVB-S/RCS architecture and to allow testing of new algorithms.

This model was executed on a desktop PC. AINE allowed the client to test and validate IP services in realistic conditions before the satellite launch.

Interactive broadband DVB-S/RCS OBP communication system (AmerHis)

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=7923

AmerHis gateway

AmerHis terminal

Satellite

Internet

Success stories III

In order to cross check optimization of a service and architecture systems, the project’s goal was to investigate the possibilities of using a network simulator to analyze the performance of the proposed new architecture.

The AINE model provided in-depth validation of the proposed new architecture, allowing the client to test and optimize the performance of new algorithms in realistic conditions.

Additional information on the usage of AINE at IP layer can be found at:

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=28656

IP-friendly cross-layer optimization of adaptive satellite systems (xLayer)

The goal of the project was to investigate how cross-layer information can help upper layers to take advantage of the adaptive physical layer present at DVB-S2. AINE was used to evaluate the different proposed techniques with real TCP/IP protocol stacks.

Success stories IV

The AINE modelled the DiffServ architecture of the DVB-S/RCS system with one DVB-S Hub and up to 51 terminals. The network model was divided and executed in two servers. AINE allowed the client to test a new architecture and to evaluate the expected QoS.

Applications layer QoS in DVB-S/RCS systems (AQoS)

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=27802

The objective of this project was to provide an overall network performance characterization of the DVB-S/RCS protocol stack and to evaluate the AINE model for the DVB-S/RCS architecture and to allow testing of new algorithms.
**AINE ADVANCED IP NETWORK EMULATOR**

Satellite communications, earth observation, navigation and positioning and control stations

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### Highlights
- Flexible and extensible new emulation model blocks can be included in the library
- Multithreaded implementation that allows efficient use of multiprocessor platforms
- Includes impairments and protocols specific to DVB-S/RCS networks
- Matlab and C++ interface
- Realistic signal fading, shadowing and Doppler shifts due to ICES and 50% configuration files
- Multithreading emails available in real-time
- Multithreaded visualization of incidence events and alarms
- Handling of monitoring events to Text, XML and HTML files, E-mail, Telnet and custom scripts
- Engineering and technical support available also remotely
- A flexible assumption with a standard Java-based monitoring and control system

### AINE characteristics

<table>
<thead>
<tr>
<th>Emulator type</th>
<th>Host type</th>
<th>Platform</th>
<th>Monitoring and control</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet in promiscuous mode</td>
<td>Linux 2.6 x86/64</td>
<td>GNU/Linux kernel 2.6</td>
<td>Java-based GUI</td>
<td>XML configuration files</td>
</tr>
<tr>
<td>Generic packet handling blocks</td>
<td>Traffic classifier, ToS marker, TTL decrement</td>
<td>Traffic conditioning blocks (token bucket), MTU limiter, delay, bit-error-rate and packet-error rate, bandwidth limitation (leaky bucket) and queuing emulation.</td>
<td></td>
<td></td>
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<td>Network monitoring blocks</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Extensible and feature rich library

- Satellite communications (DVB-S, DVB-RCS, DVB-C) and S4D, DAMA algorithms, air interface of remote stations, IP routing, IP core, ATM, DVB-S, DVB-RCS, DVB-C and externally developed simulation software
- Multithreading simulation of core applications in Random Access Mode combined to the DAMA mode, Supporting protocols like DVB-S, DVB-RCS, IP, ATM, 802-11 and 802.16

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